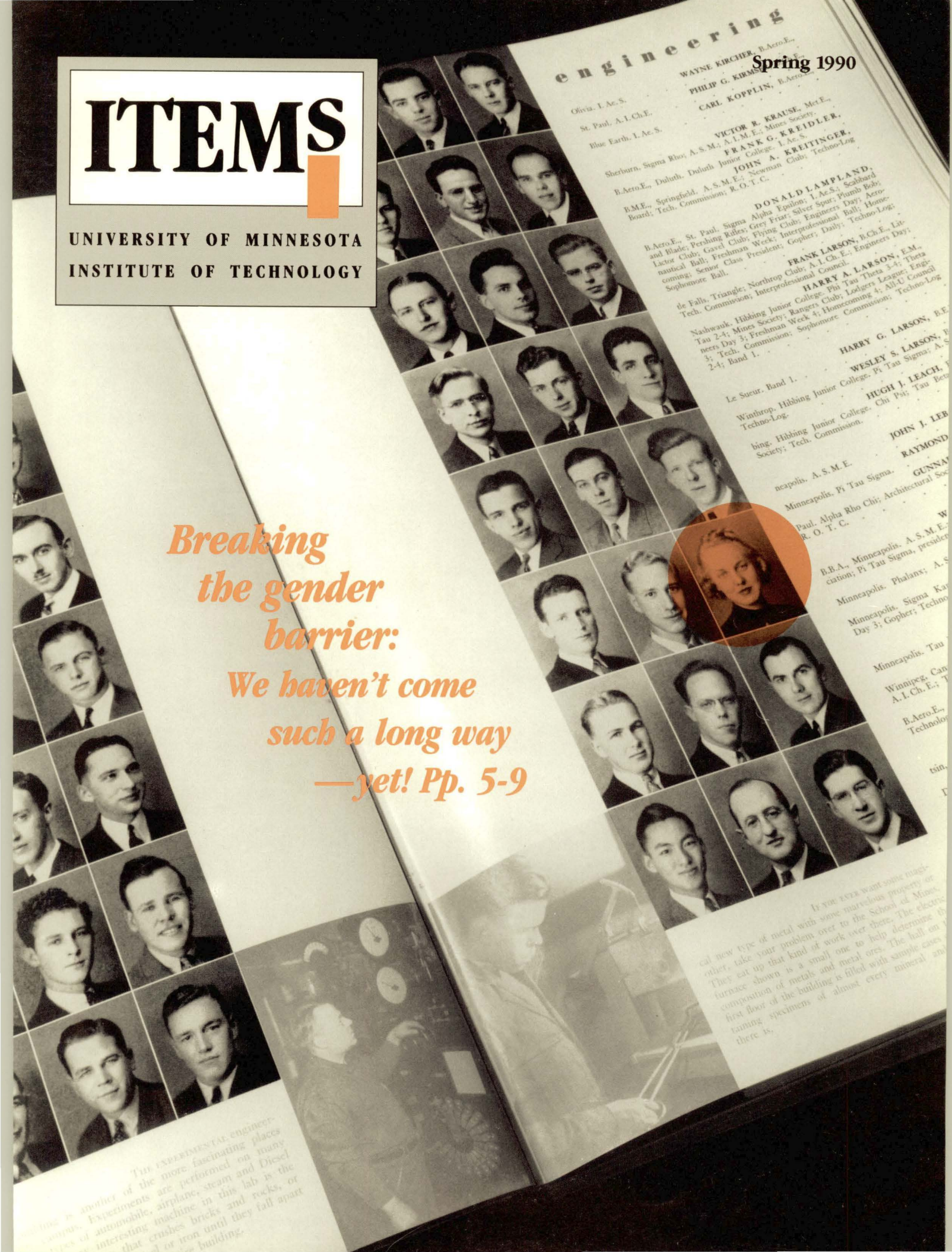
ITEMS

UNIVERSITY OF MINNESOTA
INSTITUTE OF TECHNOLOGY

Spring 1990



engineering

Breaking the gender barrier:

We haven't come such a long way —yet!

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ITEMS

University of Minnesota Institute of Technology

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Items is published three times a year to inform Institute of Technology alumni and friends about news, interesting alumni and faculty, and relevant issues. Letters to the editor, requests to receive *Items*, and notices of address changes should be sent to the Office of External Relations, Institute of Technology, 107 Walter Library, 117 Pleasant St. S.E., University of Minnesota, Minneapolis, MN 55455. *Items* welcomes letters and ideas from all readers.

This issue was prepared with the assistance of University Relations.

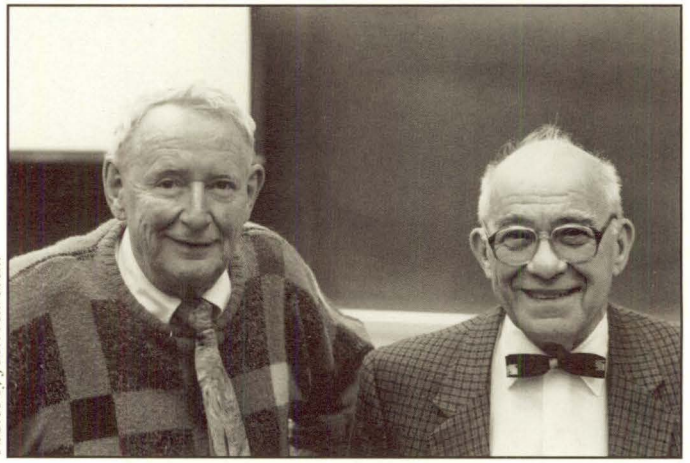
About the cover: If anything, these pages from the 1939 edition of *The Gopher*, the University of Minnesota yearbook, are exceptional in that there was a woman pictured. Most engineering and science classes during that era had *no* women students. Photograph by Tom Foley.

NEWS

Birthday bash

When the School of Physics and Astronomy threw a two-day party in February, more than 250 people from around the country showed up to celebrate. The occasion was the University's 100th anniversary of hiring its first professor of physics, Frederick S. Jones.

The celebration was a welcome diversion, according to Marvin L. Marshak, professor and head of the School of Physics and Astronomy. "Parties are good for morale," he says. "There are



Photos by John Marchetti

Regents' professor Edward P. Ney and regents' professor emeritus Alfred O. C. Nier

a lot of centrifugal forces that isolate scholars by specialty and split people apart. The centennial celebration was a good way to bring people together, to have a shared intellectual experience."

By all accounts, the Centennial of Physics on February 21 and 22 was a huge success. Guests were treated to talks on everything from physics in the 1890s to the challenges of teaching physics today. Guest speakers included two Nobel laureates: Philip W. Anderson of Princeton University and William A. Fowler of the California Institute of Technology. Other speakers were: Roy F. Schwitters of the Superconducting Supercollider Laboratory, Arnold B. Arons of the University of Washington, and Anthony P. French of MIT.

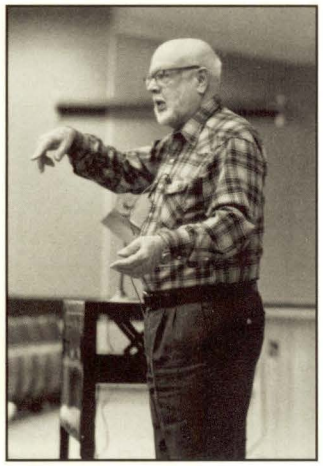
But the centennial offered more than a chance to hear distinguished speakers. It brought old friends and colleagues together after many years. Regents' Professor of Physics Emeritus Alfred O.C. Nier says he was delighted to see so many former graduate students, postdoctorates, and colleagues return for the event. "I saw a lot of people I'd known over the years and that was fun," says Nier, who arrived at the University as a freshman in 1927 and became a faculty member in 1938. "It was fitting to honor Jones. He was a first-class guy who did a lot to build this place."

Given the ambience, reminiscing became an important part of the event. A video presentation titled, "A Brief Look Back, 100 Years of Physics at the University of Minnesota," gave partygoers a chance to view the changes that have occurred since the days when Jones rode to work in his horse and carriage. The move to Jones Hall in 1902 was recounted, as was the move in 1927 to the Tate Laboratory of Physics. Also recalled was the debate over whether to move physics from the College of Science, Literature, and Arts to IT.

The centennial gave everyone a chance to remember some of the physicists who were leading forces in the department. John Tate was remembered for his work on the mass spectrograph and important physics journals, including Review of Modern Physics, The Physics Teacher, and *The Physical Review*. John Williams was noted for his work as former chair of the Atomic Energy Commission and his influence on nuclear politics. Both men were extremely influential, nationally and internationally, Marshak says.

It's important to recall the past, says Marshak. "It's good for students and faculty to feel they came from something and are going somewhere. A centennial is a way of reminding people of the history of the department. We're are not just floating in space. We're on a continuous thread."

There have been ups and downs, booms and busts, along that thread, according to Marshak. The first boom-bust period started with Sputnik in the late 1950s and peaked with the Apollo moon landing in 1969. In the decade that followed, universities were hit by a declining interest in science; by 1979, there were only 80 physics graduate students at the University.



Nobel laureate William A. Fowler

In 1980 that downward trend started to reverse. Today physics has a near-record number of 150 graduate students. But the school faces different challenges, according to Marshak, stemming in part from the trend toward specialization. Many physicists are discipline-based and often have more in common with peers at other institutions who are working on similar projects than they do with their own colleagues, he says. The challenge that lies ahead is to make "the home university" intellectually stimulating so that faculty will interact with one another. "It's incumbent on the department to try to counteract the tendency of faculty to work outside the university," he says. "People shouldn't be so narrow. It's bad intellectually for them to get in a rut. Departments have a responsibility to try to keep that from happening."

The celebration of the hiring of Frederick S. Jones certainly brought faculty out of the rut. "People were very excited about it," says Marshak. "It was a real high." In fact, it was so successful Marshak says he may just keep searching for other milestones to commemorate. I

By Miriam K. Feldman

New professorships established

IT has received endowments to establish two new professorships: the Ray D. Johnson/Mayon Plastics Professorship in Chemical Engineering and Materials Science and the J.S. Braun/Braun Technologies Group Professorship in Science and Technology.

The first professorship was endowed by Ray D. Johnson, who received his bachelor's degree in chemical engineering from IT in 1939. It is designed to "maintain and expand upon the present strengths of the Department of Chemical Engineering and Materials Science and to provide an excellent mechanism for retaining and attracting young teachers and scholars seeking tenure in the department."

The second professorship, which was endowed by J.S. Braun and the Braun Technologies Group, is designed to attract outstanding visiting professors to the Departments of Civil and Mineral Engineering, Geology and Geophysics, Chemistry, and the School of Public Health's Division of Environmental and Occupational Health to address issues related to geotechnical, construction materials, pavement, and environmental engineering, as well as hydrogeology, chemistry, and industrial hygiene technologies. I

Noted

The Board of Regents voted in April to establish a single tuition rate for undergraduates on each of the five campuses. Under the current tuition structure there are 18 different rates for undergraduate tuition. The single tuition rate will be phased in during a three-year period. The single tuition rate will mean increases for approximately three out of four students, but tuition rates should decline for upper division IT undergraduates.

■ Anne Hopkins, former vice provost at the University of Tennessee—Knoxville, was named to the newly created position of vice provost for arts, sciences, and engineering of the Twin Cities campus. Among other duties, Hopkins serves as the chief academic and administrative officer for IT. ■ Lori Lucke, a Ph.D. student in electrical engineering, received a 1990 AT&T Bell Laboratories Ph.D. Scholarship. Nationwide, only 29 students from a pool of 243 nominees received scholarships.

■ Timothy J. Callahan, a senior in electrical engineering, won a full scholarship from the Winston Churchill Foundation of the U.S. for a year of graduate study at Cambridge University, England. ■ Kresimir Zic, a Ph.D. candidate in civil engineering, received the Alvin G. Anderson Award for his research on the effects of bubble plumes on stratified water bodies. Anderson was a former professor of civil engineering and director of the St. Anthony Falls Hydraulic Laboratory.

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Career workshop for chemistry grad students

The chemistry department, in conjunction with IT, sponsored a one-day career planning workshop for graduate students in March. Seventy participants discussed career opportunities in academia and industry, as well as such topics as how to balance family and careers, with a group of speakers and panelists recruited from industry, academia, chemistry department alumni and faculty members, and career development and placement professionals. Dr. Margaret Cavanaugh of the National Science Foundation delivered the keynote address and spent several hours talking informally with women students and postdocs on a wide variety of professional development topics.

Panelists reported on a variety of subtle, difficult-to-detect barriers that commonly obstruct the normal career progression for women. Industry managers described several routes to a career in management, pointing out that in some industries MBAs are the norm, while in others they are practically nonexistent. The workshop also provided an opportunity for students to establish contact with chemists outside the University community and laid the groundwork for continued professional networking. The department plans to organize the workshop on an annual basis and schedule brown-bag career seminars throughout the year. I

■ David Rowe, a junior in electrical engineering, received the $1,000 Donald J. Herman scholarship from NCR Comten. The scholarship was established in 1989 to commemorate the retirement of Donald J. Herman, a founder and former CEO and chair of NCR Comten. ■ Three Honeywell W.R. Sweatt Lectures in Technology Leadership were delivered this spring. Speakers were: H. Harry Bebb, vice president of product architecture for Xerox Corp.'s Development and Manufacturing Group, March 15; John Kenneth Galbraith, Harvard's Paul M. Warburg Professor of Economics Emeritus, April 26; and Daniel C. Drucker, University of Florida graduate research professor of aerospace engineering, May 17. Monographs and videotapes of the lectures are available from the Center for the Development of Technological Leadership, 107 Lind Hall, 207 Church Street S.E., Minneapolis, MN 55455. ■ Professors Janos Grantner from Hungary and Robert Stewart from Strathclyde University, Scotland, are visiting the Electrical Engineering Department spring and summer quarters. ■ Jean-Michel Dupin, Universite Pierre et Marie Curie, Paris, France, was appointed an honorary fellow of the civil and mineral engineering department during a visit spring quarter. He worked with adjunct professor Peter Cundall on geo-engineering research. ■ Thomas Manteuffel, professor and director of the Computational Mathematics Group, University of Colorado, was the Cray Endowed Lecturer in the computer science department spring quarter. Other distinguished lecturers included: Shimon Ullman, Massachusetts Institute of Technology, John McCarthy, Stanford University, James C. Browne, University of Texas at Austin, S. Rao Kosaraju, Johns Hopkins University. I

Honeywell chair named

On February 1, the third of four chairs endowed in 1987 by Honeywell Inc. was named for Edson W. Spencer, retired Honeywell board chair and CEO. The Edson W. Spencer Land-Grant Chair will be established in the Center for the Development of Technological Leadership, which is a joint program of IT, the College of Liberal Arts, and the Carlson School of Management.

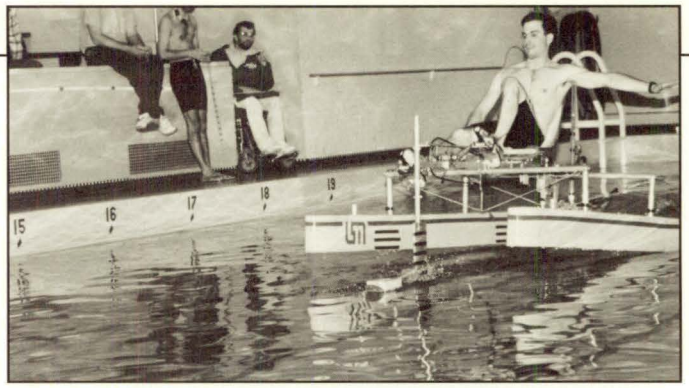
Spencer, a former Rhodes scholar, joined Honeywell in 1954. He served as president and CEO from 1974 to 1987 and as chair of the board of directors from 1978 to 1988. Spencer is a director of CBS, chair of the board of trustees of the Ford Foundation, and a member of the board of trustees of the Mayo Foundation and the Carnegie Endowment for International Peace. I

Algot Johnson classroom dedicated

A classroom in the Civil and Mineral Engineering Building was dedicated in April in honor of the late Algot Johnson, a 1910 graduate of the former School of Mines and founder of the Al Johnson Construction Co. of Minneapolis. In 1985, members of Johnson's family and company established the Algot Johnson Fund for the improvement of the civil and mineral engineering department. The first project supported by the fund was the remodelling of the classroom named in Johnson's honor.

Johnson was an active supporter of many University activities and assisted more than 50 University students through the Al Johnson Foundation Scholarship. He received the University's Outstanding Achievement Award in 1966. I

Photo by Michael Moffa



Mark Moffa, brother of senior mechanical engineering student Michael Moffa, was recruited to pedal the hydrofoil during test runs in Norris Pool in January.

Strange locomotion

Students in mechanical engineering professor Arthur Erdman's design morphology class are hoping to pedal their way into history this summer. During the past three years, successive classes of design students have continually refined a pedal-powered hydrofoil with hopes of winning an international competition to be held in Portland in August.

Students from more than 50 colleges and universities worldwide will be competing to break the world record for a human-powered hydrofoil (16.9 miles per hour), according to Erdman. The IT group is currently working on a fourth-generation prototype.

"We never actually built the third-generation machine," said senior mechanical engineering student Joe Bergmann. According to Bergmann, after conducting a computerized finite element analysis, the class decided to redesign their hydrofoil. The new craft was assembled during spring quarter and, with the warmer weather, trial and training runs were moved outside.

Bergmann, like many other students involved in this project, will no longer be a part of the class when the competition takes place. Although a few students have participated in this project for more than one quarter, roughly 80 percent of the students in each class are newcomers to the project, according to Erdman. Come August, the thrill of victory—or the agony of defeat—will be shared by a sizeable portion of the mechanical engineering student body. I

IT hires new development officer

John W. Larson, former associate director of the National Campaign Office for the Massachusetts Institute of Technology (MIT), joined IT Administration as devlopment officer on May 10. Larson, 32, had performed fundraising and other duties for MIT since 1986, working with groups of alumni in high-tech manufacturing areas such as Silicon Valley and Route 128.

Larson is a 1980 graduate of MIT, with bachelor's degrees in chemical engineering and international business management. After graduating from

Photo by Patrick O'Leary

John W. Larson

MIT, Larson worked for ARAMCO for six years, first in their professional development program and later as a project engineer. I

Photo courtesy of University Archives

Former professor and aeronautical engineering department head John D. Akerman, lower left corner, with aeronautical engineering students and faculty members in 1949

By Maggi Aitkens

Breaking the gender barrier

More women are needed in science and engineering, but many subtle—and some not so subtle—barriers still bar the doors

Times *have* changed. Gone are the 19th-century days when women interested in science and engineering were restricted to working rather "invisibly" as illustrators of scientific textbooks. Enter an era when the accomplishments of Rosalyn S. Yallow, who won the Nobel prize for medicine and physiology in 1983, and Sally K. Ride, astronaut, speak for themselves. But have times changed enough? Can you name more than three or four female scientists and engineers either from your current workplace or from your days at the Institute? It's clear the Yallows and Rides of this world are still the exception.

With drastic shortages of scientists and engineers looming on the American horizon and an IT faculty that just barely squeaks past the 5 percent mark when it comes to women (not unlike many other academic institutions nationwide) the administration at the Institute decided it was time to launch a proactive program to change that picture.

Enter Sally Gregory Kohlstedt, the Institute's first female dean. As associate dean for faculty development and special projects, one of her primary responsibilities is to recruit and retain more women faculty and graduate students within the Institute. To Kohlstedt, who is also a professor of history of science and technology, women's interest in science and engineering is a given, as is their ability to excel. Consequently, she sees the challenge of attracting more women to the Institute as twofold: overcome the barriers women confront in these fields, and change the environment in a way that not only accommodates women but that is hospitable to them in their work. Her strategy toward this end can be summed up in one word: action!

The Need: A Mathematical Equation

When it comes to explaining the need to recruit more women scientists and engineers, numbers alone tell the story. The National Science Foundation has projected a shortage of some 675,000 U.S. workers with bachelor's degrees in engineering and natural science by the year 2006. During that same period, more than 24,000 new jobs for those with doctorates will be created annually, while less than 10,000 doctoral degrees are likely to be granted each year. Since scientists and engineers form the foundation of the technological, economic, and military might of any advanced industrial society, it is perhaps not surprising that more than a few

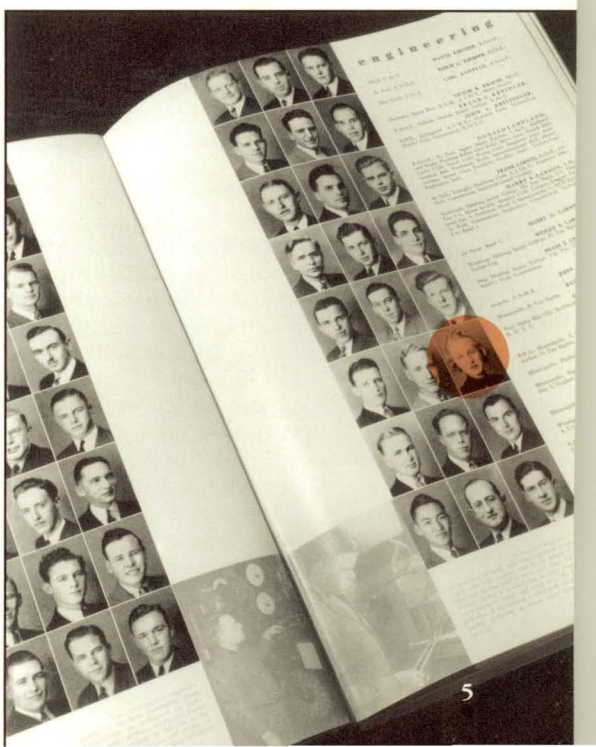


Photo courtesy of University Archives

Although the number of female students was still small, chemistry was among the most popular choices during the 1930s for those who chose to ignore the gender barrier

flags have started to wave across the country; these figures predict hard times ahead.

One more statistic must be added to the equation to fully grasp the importance of women in resolving the problem: of the new workers entering the labor force in the next 10 years according to the department of Labor, only 15 percent will be white men. The rest will be white women (42 percent), members of minority groups (20 percent) or immigrants (22 percent). Women overall will comprise 64 percent of this new labor force, while men will constitute only 35 percent.

You don't need to be a mathematician to conclude that (1) something needs to be done immediately to increase the number of scientists and engineers in America, and (2) the largest pool on which to draw will be women.

Universities nationwide, as a result, are in a precarious position. They will be largely responsible for solving the shortage problem by graduating more scientists and engineers at the same time that their own pool of candidates for faculty positions in science and engineering is diminishing.

"There is no doubt that the faculty talent in the coming decade is going to be rather thin," says IT dean Ettore Infante. "Institutions nationwide are going to be looking to the same pool from which to recruit at a time when there are fewer candidates. If we at IT could 'corner' the market of women faculty members by developing a reputation as an institution that facilitates the entrance of women in science and engineering at both the faculty and student levels, we will really be helping ourselves."

When it comes to numbers, however, Infante doesn't stop there. While more than half of the total freshman class at the University is women, within IT, women constitute less than 20 percent of the total undergraduate population. At the graduate level, the number shrinks to a mere 10 percent. At the same time, women comprise 51 percent of the U.S. population and 45 percent of the nation's work force, yet they are only 11 percent of all employed scientists and engineers.

"People worry about wasting natural resources," says Infante. "But what about human resources? There's an enormous amount of talent out there that's not being utilized. Something needs to be done to help these people succeed. If I can leave this position knowing I did everything I could to help women achieve their potential in science, I will know I have succeeded."

In the best of all possible worlds, Infante sees nothing less than a 50-50 ratio of men and women. "But I shouldn't be painted as Candide's Pangloss either," he adds. "Although we would like to move very quickly in that direction, the truth is that these things take time to change and this world isn't necessarily the best of all possible worlds when it comes to these matters."

Obstacles: A Cultural Issue

The best of all possible worlds, for example, would be absent of stereotypes and conditioning that shape our perspective, self-image, and even career choices at very early ages. According to most experts, many girls lose interest in mathematics and science, particularly at the junior high school level, even though they are as competent as their male classmates because they perceive these to be fields reserved for boys.

For those women who do make it through the educational pipeline with their interest in mathematics and science intact, other barriers confront them, including feelings of isolation, loss of self-confidence, and communication difficulties.

"Being the only woman in a faculty of all men, by definition, is a hostile environment," says Haeok Lee, assistant professor of mechanical engineering. "It's stressful, even if everyone is trying to be very nice, which has been my experience. You carry that extra burden of having to succeed. You're a pioneer, paving the way, and it's up to you."

Stress also results as women try to combat their feelings of isolation by making efforts to "fit in" with the predominantly male environment. "If you go to a school where there aren't many women, you start to feel defeminized," says Deborah Schnur, a Ph.D. student in mechanical engineering. "You want to do anything you can to blend in with the people around you so you'll be taken seriously—and nail polish and make-up aren't a part of that. You de-emphasize your appearance. But it's a Catch-22. People in general tend to look down on you for being that way—almost like you're not a real woman—but if you didn't, they wouldn't take you seriously. What's more, if you manage to fit in with the engineering environment, chances are you won't feel like you do elsewhere in society; and if you fit in with the rest of the world, you won't fit in with engineering."

The differences in the way men and women interact can also play havoc with a woman's sense of self-confidence when she works in a male-dominated field. "Women tend to be relatively nonconfrontational when they interact with each other," says Schnur. "As a result they seem to back down more than men in the face of opposition. For myself, I take criticism about my work more personally than men do. In research you're always being attacked on your ideas. That's just part of the process as it stands now. But I'm not sure it has to be that way."

According to Schnur, men and women also tend to present themselves differently in the academic setting. "When I took my preliminary exam," she says, "I wasn't sure of some of my answers so I came across looking hesitant. Some of the committee members, all of whom were male, later said that I was not aggressive enough and that even if I wasn't sure of my answers, I should have solidly put forth my position as though I was. I think men seem able to act sure even when they aren't, but women as a rule have more difficulty doing that."

That's why it is so important to ensure —at least for the time being—that women are represented on important committees, such as search committees, says Lee. "Women as a rule don't present themselves the same way as men do on paper," she says. "In addition, when men write letters of recommendation for their women students, they often tend to include information about personality and somehow slightly trivialize the woman's intellectual capabilities by saying she's 'bright.' Committee members need to take that into account rather than judging the applicant's file at face value."

"The administration has always been more than willing to help improve the environment for women at IT, however, they didn't really know what should be done."

We're all aware of this phenomenon—or at least we should be. When a junior high school girl is good in mathematics, for example, she is oftentimes called a "hard worker." A boy, on the other hand, is a "good mathematician." While women have "good intuition," men have "good judgment." Likewise while a woman might be called "picky" or "emotional," men are "detail oriented" and just plain old "angry."

All these factors undermine women's ability to succeed and increase feelings of self-doubt. A recent study shows, for example, that women enter college with better GPAs than men, tend to finish in a shorter time, and graduate on the average with higher GPAs. However, when these women were asked if they felt capable of doing good work once they graduated, they said they didn't feel qualified or capable. "By the time they graduate," says Lee, "they've totally lost their self-esteem. A lot of them drop out and never go to graduate school or pursue challenging careers."

Most women faculty and students who leave the fields of science and engineering do so because they feel they just can't "cut it." Unfortunately, some are unaware that much of their difficulty stems from the stress associated with feelings of isolation. Lee, for example, only noticed that she was experiencing stress as a result of being the sole female faculty member in mechanical engineering when another female faculty member was hired. "Most women have had no experience with really good environments," she says. "Before Sally was hired, I thought this was the way it was, and if I couldn't make it, it was because of me. Rather than look for positions elsewhere, I would have been more apt to leave academia."

Obstacles: A Structural Issue

In addition to cultural differences, women scientists and engineers also confront barriers in trying to enter a structure that in many cases does not readily accommodate them. These obstacles are found in the lack of role models, limited access to information, family concerns, sexual harassment, and discrimination.

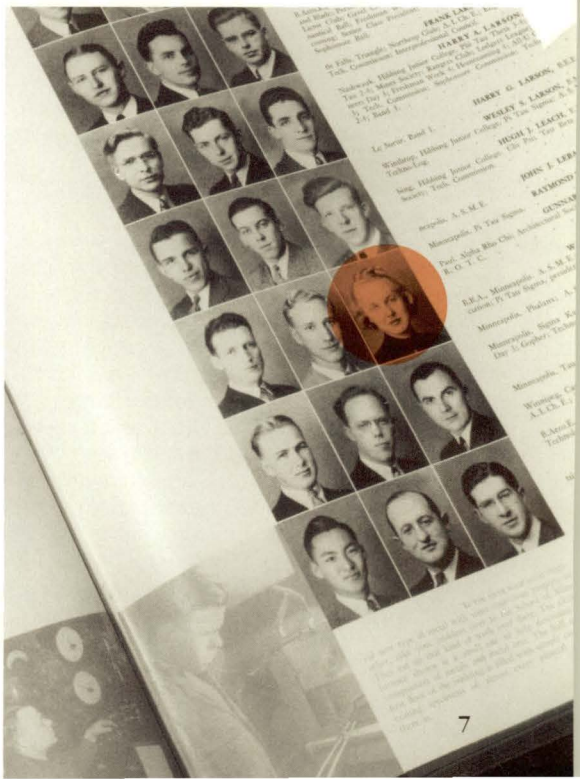
Men share two important characteristics that most women don't: first, they have male colleagues in higher positions. Second, they have open access to a club commonly referred to as the "Old Boys' Network." These two factors combined create an environment in which men not only have role models, but have access to important information, much of which flows naturally and informally among them over lunch, on the golf course, or at a poker game.

"In most cases, women are not part of that structure," says Lee. "It's important for women to have a way to share information that is necessary to do well and succeed." Because of her position, Kohlstedt not only has access to this type of information, but

Assistant professor Haeok Lee

Photos by Patrick O'Leary

Associate dean Sally Kohlstedt



has been able to create a structure where it can be effectively shared. Last fall, she organized a retreat for all women faculty and a series of monthly meetings to do just that.

"She has provided us with important information about how search committees work, the evaluation process, what is going on, who makes decisions about what, and other matters that are critical to our work," says Lee. "In terms of changing the climate, she's already had a very important effect. There's a definite improvement in the morale among women faculty. We feel supported. That's not something you can measure necessarily, but it's there."

"The networking among women faculty has been very positive," says Catherine E. French, assistant professor in civil and mineral engineering. "Because of the people I've met, I know more about what's happening around IT. You not only gain different perspectives from the women working in various areas about engineering and science, but you're able to learn from women who have sat on committees about such matters as promotion and tenure and what you should do to better prepare yourself. This type of mentoring among the faculty has been really encouraging."

According to French, Kohlstedt has also been extremely effective in providing information and statistics about women coping with stress, families, and other issues so that they will be better prepared to recognize and deal with the specific problems they face as women in male-dominated fields.

In addition, during their 20s and 30s—just when their careers demand the most time—women face decisions about childbearing. It may be one reason why the Institute loses a fair number of women between the master's and doctorate levels. "Most of the women I know have decided to put off childbearing until they complete their degrees," says Schnur. "But in the back of our minds, we can still hear that biological clock ticking away and wonder if we decide when we're thirty-something to have children, whether it will be too late. Nonetheless, I just can't imagine trying to do this with children."

Because a number of women faculty are balancing both families and careers, what works for men moving up is not necessarily the same as what works for women. "At the University, for example, if you work less than two-thirds of a year, that year will not count toward tenure," says French, who just delivered her second child last month. "On the one hand, you see your colleagues advance faster than you do, even though you're still working just as hard trying to keep up. On the other hand, it's nice to have that choice because it does take some of the pressure off.

"With 55,000 students plus faculty, the day-care center at the University is not very adequate because they only accept a handful of infants each year," French continues. "If you want to care for or feed your child, it would be nice to have some place on campus for infants."

"It's imperative that we think about child care," says Kohlstedt, who believes it would make a difference in not only attracting more women faculty and graduate students but also in retaining those who are here. "If Twin City companies can do it for their employees and the state legislature can do it for its employees in state office buildings, I don't see why it can't be done here." Although nothing is in the works yet to launch a new day-care center, if Kohlstedt's enthusiasm on this topic is any indication, it may not be long before both men and women can enjoy the company of their children on campus.

"They need to know that families and careers can be balanced, that they won't be totally isolated, and that it's a workable situation."

Women who manage to overcome these hurdles and remain in the work force nonetheless tend to be paid less and promoted less often than white men. In a 1989 survey of 1,000 women engineers conducted by *Design News* and the Society for Women Engineers (SWE), more than 47 percent of the respondents said one of their primary frustrations on the job was that they were paid less than their male counterparts and more than 27 percent complained of not getting a justifiable promotion. In 1985, the few women on college and university science faculties nationwide were more than twice as likely as men to be in nontenure-track positions.

The *Design News*/SWE survey also reported that more than 52 percent of the respondents said they had been sexually harassed on the job, while more than 51 percent complained of being given token assignments. Issues such as whether or not it's appropriate for men and women to travel together on business or how effective a woman can be on a job site of 200 men, for example, are still unresolved even in these supposedly modern times. As a result, women are sometimes reduced to holding lower levels of responsibility than their male counterparts, regardless of their abilities.

"Most of us were brought up in very male environments," says Infante. "I don't think that we in science and engineering are purposefully sexist, but on the other hand, I don't think the problem has ever hit us. Until I became dean and did a considerable amount of thinking about this, I was really unaware, for example, of the importance of mentors or role models. Fundamentally, it's the kind of problem that's not going to go away until there are more women."

The lack of mentors and role models for women is the most important reason why women choose not to pursue advanced studies or careers in these fields according to experts. Perhaps because of the importance of mentoring, women who receive science degrees from women's colleges—where the faculty is 45 percent female—earn twice as many Ph.D.'s as women who attend coed institutions.

Minnesota is particularly lacking in this area. It has a much lower proportion of women teaching secondary and middle school science courses—particularly physical sciences and mathematics—than most other states in the nation. Girls taking advanced math or any of the physical sciences in high school or junior college rarely have a woman teacher.

The Pipeline

With the numbers in and tallied, it's clear to see that Kohlstedt has a difficult job in front of her. How do you recruit talented women faculty, for example, if there aren't many out there with Ph.D.'s in science and engineering?

"When I realized how tight the marketplace is for the very few women who have degrees in science and technology, I knew I needed to address the pipeline issue if we're to succeed in recruiting more women faculty members at IT," says Kohlstedt. "Unless I work simultaneously on the problem of getting women interested in mathematics through junior high and high school so they're equipped and encouraged to take college and graduate school courses so they can pursue academic careers, we're not going to change the proportion of women in this field."

Kohlstedt was quick to identify a ready-made group to help her with this endeavor: other IT women faculty and graduate students. "I've found that most women in science and engineering are really committed to increasing the pool of women," she says. "They see no value in being unique and exclusive in their positions, and they want to network—not just with each other to advance their own careers, but with other young women to help them get their careers on track."

Kohlstedt and her colleagues began at the graduate level by organizing a reception for these students last fall and scheduling a series of informal luncheon meetings

throughout the year. The meetings have given students valuable opportunities to get to know other women within IT, which eliminates some feelings of isolation and provides Kohlstedt and her colleagues an opportunity to inform them about the pros and cons of pursuing academic careers.

"They want to know what it takes to succeed, how we went about it, and what it's like to balance a career and family," says French. "Some have concerns about the experiences they have had as far back as high school. Some had support, while others were discouraged from pursuing the field. They need to know that families and careers can be balanced, that they won't be totally isolated, and that it's a workable situation."

"Before Sally instigated these luncheons," says Schnur, "I didn't know there were that many women at IT and that many of them were going through the same thing as me but in different fields. Because of Sally, we now have a much bigger support group."

Kohlstedt also began taking proactive steps to enhance graduate school recruitment efforts by encouraging departments to broaden their scope in their search for candidates and by focusing attention on IT's undergraduate population —a place where most women get "lost." In electrical engineering, for example, only 2 percent of the 2,500 or so women who annually earn undergraduate degrees nationwide go on to receive doctorates.

"We're trying to convey the message that, first, you don't have to be a straight-A student to go on to graduate study and that, second, you won't necessarily be adding to your debt burden," says Kohlstedt. "Most graduate study in science and engineering is paid through teaching assistantships and research assistantships, so it's possible to go to graduate school and not invest more. You won't get rich, but you won't have to go broke, either."

Kohlstedt has organized meetings in which graduate students and others meet with the undergraduate women to talk about what is's like in graduate school and to convince them that it's worth considering as a viable option either immediately or in the long term.

At the high school and elementary levels, Kohlstedt has identified a number of programs sponsored by the school system, SWE, and local corporations, such as Honeywell and 3M, that work to interest kids in mathematics and science. She hopes to organize a meeting in June with the people involved in these programs to share ideas that have been successful and perhaps organize a type of steering committee to share resources.

"My work with the graduates and undergraduates is to ensure that a group of women who have already made a commitment to science and engineering stick with it," says Kohlstedt. "But this isn't going to increase the total number of women unless we start much earlier. Although the University can't really be in the business of doing outreach, we can certainly facilitate what other groups are already doing by helping to coordinate them.

"The real issue is at the elementary level," says Kohlstedt. "Children have a hard time imagining what it is that someone does in science and engineering and so they can't imagine themselves doing it. For girls, it's particularly difficult because they just don't see women doing those things. If you can let them see a walking, talking female scientist who's excited about her work and who otherwise looks perfectly normal, the field might seem more interesting than some of the other options they've been considering."

If Kohlstedt hadn't found the pipeline, chances are the pipeline would have found her. Even with the limited time she has been at IT, she has already received calls that run the spectrum of careers and age levels—a father seeking advice on how to counsel his 9th-grade daughter about careers in mathematics, a mother trying to find ways to interest her daughter in science and technology, and numerous requests for speaking engagements at local junior colleges and other institutions.

"I think I've suddenly become a resource to people who, because they don't move in the same circles as I do, don't know about available options, such as programs generated through the National Science Foundation, or what a girl can do if she's good at mathematics and science," says Kohlstedt.

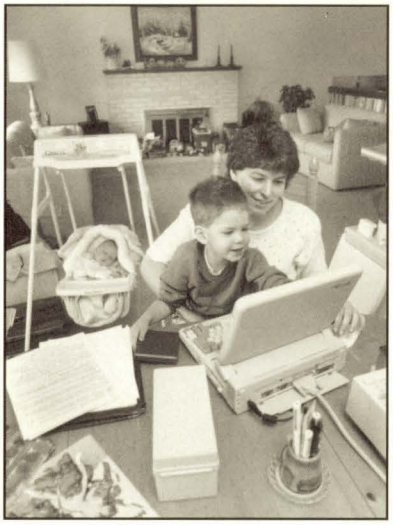
"I think people learn a lot from each other, rather than from an expert handing them information," she adds. "Hence, the importance of luncheon meetings, networking, and coordinating the efforts of local activities. I'm trying to facilitate discussion that permits shared learning, rather than being the expert. I think of myself as an enabler—someone who enables other people to reach their potential."

With Kohlstedt on board, gone are the days when the women faculty will have to struggle either individually or jointly defining ways to improve the environment. "The administration has always been more than willing to help improve the environment for women at IT," says Lee. "However, they didn't really know what should be done. There's only so much that we, as academics can do because we're supposed to be doing our work. Sally fills that role. She figures out what actions may be useful so that we don't have to spend our time defining the problems and offering the solutions. She's also a source of energy for us in terms of helping us generate ideas. We can participate in that process without feeling as if we're going to be penalized in terms of our professional development."

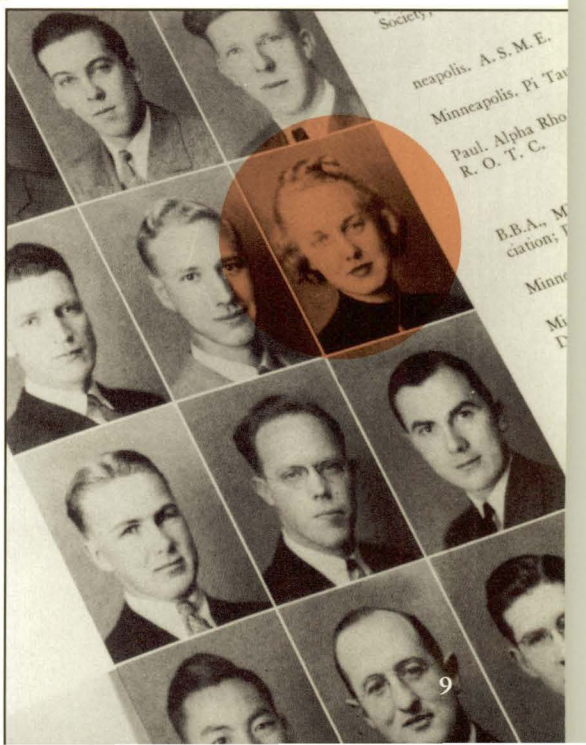
Of one thing Kohlstedt is sure: that women can be assured they'll be taken more seriously now than they might have been in the past. "We're establishing a positive image for IT out there in the larger world," she says, "and everything we do at every level helps make that happen. When we actively recruit women faculty and graduate students, we're sending a message about our commitment. And it's a very important message." I

Maggi Aitkens is a free-lance writer living in Minneapolis.

Photo by Patrick O'Leary



Assistant professor Catherine E. French trying to work at home



3...2...1...

Aerospace students help NASA launch shuttle design project

By James Marti

If all goes well, in just six years the U.S. will launch a fully functioning space station—named Freedom—into a permanent Earth orbit. Space station Freedom will serve as a staging area for future deep-space missions, a floating factory for low- gravity and high-vacuum processing, and a high perch for scientific research. With a permanent crew of astronauts living on board, at least one glitch remains: how to shuttle supplies, including food, water, fuel, and building materials—not to mention station refuse—between Kennedy Space Center and Freedom.

The problem is, there simply aren't enough space shuttles to meet the projected supply needs of the space station. While the idea of a new system to augment the current fleet of space shuttles had been floating around NASA for some time, the Challenger disaster suddenly made arguments for diversifying NASA's shuttle fleet painfully clear. It also became clear that it doesn't make sense to expose personnel to the hazards of space travel on routine missions when an automated spacecraft would be more suitable.

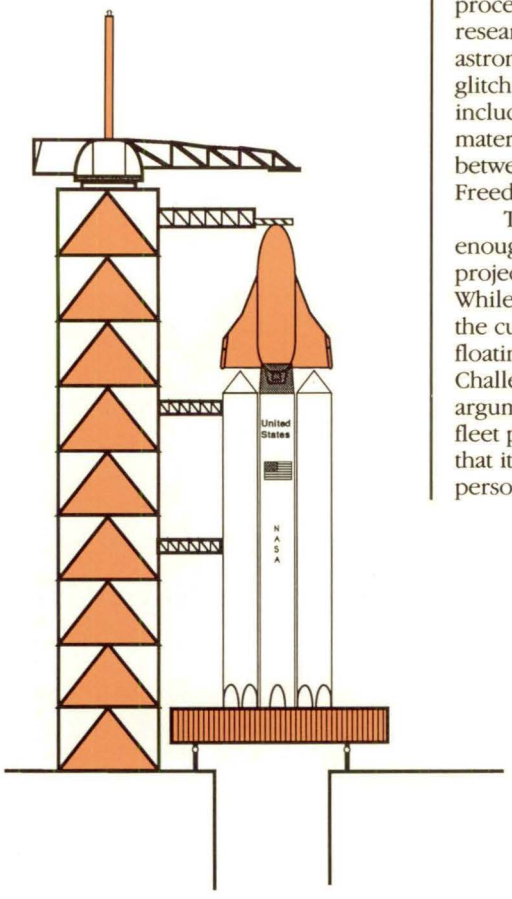
The answer is a space vehicle along the lines of the one taking shape in Akerman Hall. The Cargo Return Vehicle, or CRV, is a reusable, remote-controlled cargo craft that does not require humans aboard. Along with their professor, Andrew Vano, and teaching assistant Steve Cook, senior aerospace engineering and mechanics students have been working for the past academic year with NASA engineers at the Marshall Space Flight Center in Huntsville, Ala., to design such a spacecraft. If they are successful, aspects of their design will be incorporated in NASA's final CRV.

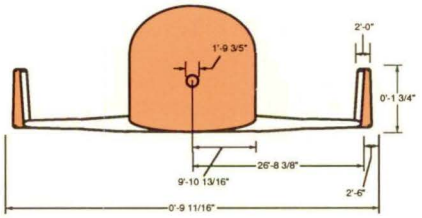
Professor Vano and his students entered the picture last fall by way of the Universities Space Research Association

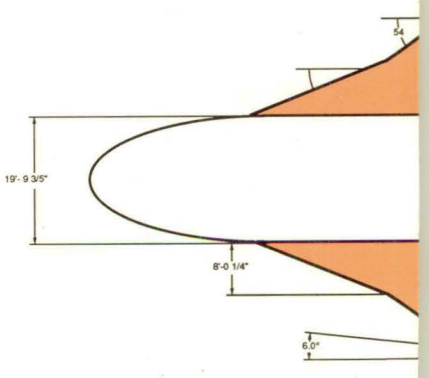
"This was probably the most real-to-life, useful class I've taken."

(USRA), a national organization that sponsors working partnerships between universities and the space agency to develop projects of interest to NASA. Currently, 43 universities work with NASA research facilities through USRA.

The current space-vehicle project is the first USRA-sponsored collaboration between Minnesota engineering students and NASA. It began with a suggestion to Vano by an aerospace engineering graduate about two or three years ago to look into the USRA







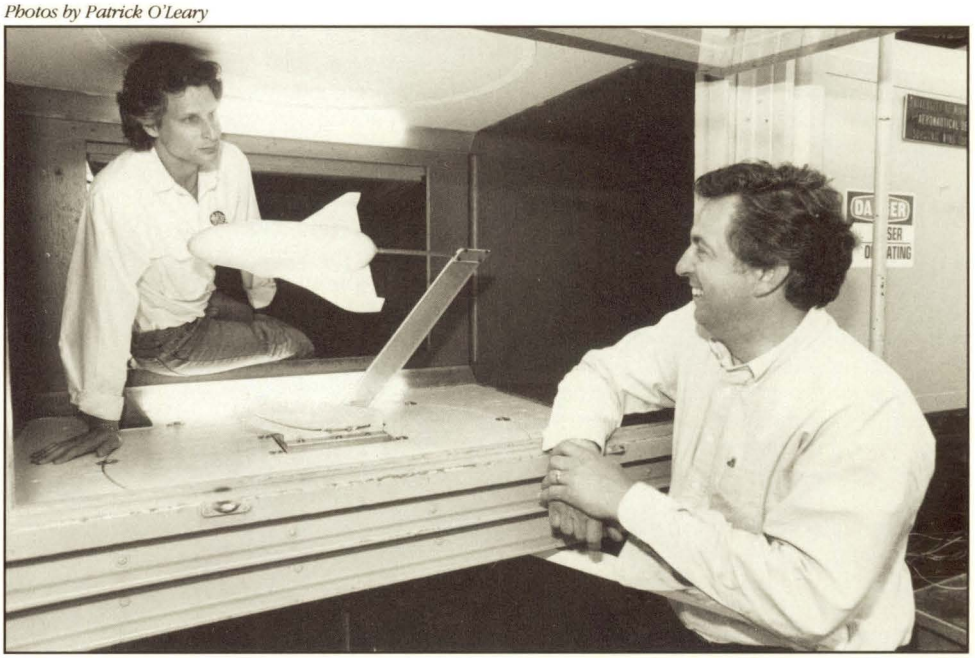
Blastoff!

Photos by Patrick O'Leary

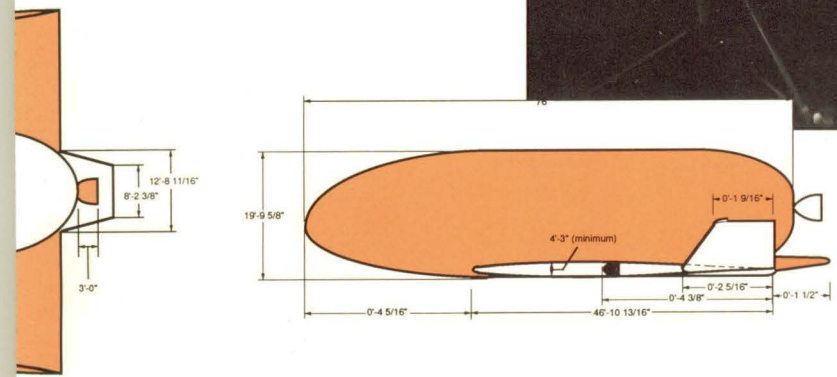
Advanced Design Program, which Vano did. Minnesota's proposal for the project was approved, and NASA's Marshall Space Flight Center chose the aerospace engineering and mechanics department as its academic partner. Together with Marshall personnel, Vano and Cook selected the CRV as the design project for the first year of what is expected to be a three-year partnership.

Cook spent most of last summer working at Marshall Space Flight Center with NASA personnel, collecting some 250 resource documents for design students to use. He also brought back computer design programs used by NASA to calculate the aerodynamics of arbitrary bodies, simulate spacecraft trajectories during reentry, and analyze structural stresses upon airframes. These were no training models—all were state-of-the-art programs used by advanced designers on a daily basis.

The requirements for the vehicle presented to the class by NASA were minimal. "They had an open-ended problem," says Vano. "We wanted to specify as few requirements as we could, because part of the design process is identifying the requirements." The CRV had to meet all resupply and payload-return needs of the space station. It was not to be used for the transport of personnel, although use as an emergency crew rescue craft was not ruled out. It had to be at least partly reusable and be able to land on runways at Kennedy Space Center or Edwards Air Force Base. Since those landing sites are farther north than the orbital position of the space



Top: **Student Steven Kress and adjunct professor Andrew Vano prepare the CRV model for wind tunnel tests.** ***Bottom:*** **Teaching assistant Steve Cook and students Christopher Thyen and Randy Rowan run a final instrument check.**



station, the vehicle would have to generate sufficient lift, by wings or other means, to get it into landing position. The students reviewed the NASA and industry technical reports compiled by Cook on three design alternatives. At the end of fall quarter, a winged vehicle similar to the space shuttle and a biconic design had been judged worthy of further study.

The class split into two project teams winter quarter to pursue the two designs and then into working groups by subsystem or discipline, much as is done on large professional engineering projects. Students were asked to apply for a position in a particular group by submitting resumes and cover letters. (Hardly your average classroom assignment!)

Although the student designers were in contact with NASA engineers via Vano and Cook, they were not told about new NASA developments on these projects so their design would be uniquely their own. Students soon found that communication was essential to the team approach. "I put the bulk of the burden—not only for doing the work, but for interfacing between discipline groups—on the students," Vano says. For example, the thermal-protection group had made a decision on their system that resulted in the thermal protection burning off completely when craft was guided through a simulated reentry trajectory designed by the reentry team. Simply increasing the thickness of the thermal protection would have had consequences for several other working groups. It was up to the design-group members to arrive at a compromise.

A key lesson throughout the exercise was the need for communication and cooperation versus trying to go it alone, according to Cook. "School teaches you to work by yourself," he says. "The world is working toward a working group."

By the end of winter quarter, the two project teams had completed detailed presentations on their winged and biconic vehicle designs. The winged vehicle looks like a miniature space shuttle, 76 feet long with a wingspan of 58 feet. In place of the large engines found on the space shuttle, one small nozzle for the orbital maneuvering system protrudes from the rear. Small vertical winglets rise from the tip of each wing, giving the winged design a graceful look. The biconic design looks like an overgrown Gemini capsule that was bent a bit on landing. It is 59 feet long with short maneuvering wings and is the more radical of the two designs. The biconic shape generates some lift, but to get extra lift when descending for landing, it deploys a ram-air parasail—a scaled-up version of the sort used by sport parachutists. By using this soft wing, the biconic design can save on weight and maximize payload.

During spring quarter, the class will validate their designs with computer programs and build scale models for wind-tunnel testing in Akerman Hall and water flow testing at the St. Anthony Falls Hydraulic Laboratory. In June, they formally present their results to NASA and aerospace industry representatives at an USRA/NASA-sponsored conference at the Lewis Research Center in Cleveland, Ohio. NASA engineers will then consider which aspects of the Minnesota design to incorporate as they continue development of the CRV.

From the beginning, the CRV design project was seen as a way to improve and diversify aerospace engineering and mechanics upper-level course offerings. Students seem to agree. After the project had been integrated into the department's senior-level design class, seniors had the choice of completing a three-quarter CRV project design sequence or taking a more conventional one-quarter class in aircraft design. Fifty-seven of the 90 department seniors opted for the NASA project and a chance to see some of their work launched into orbit.

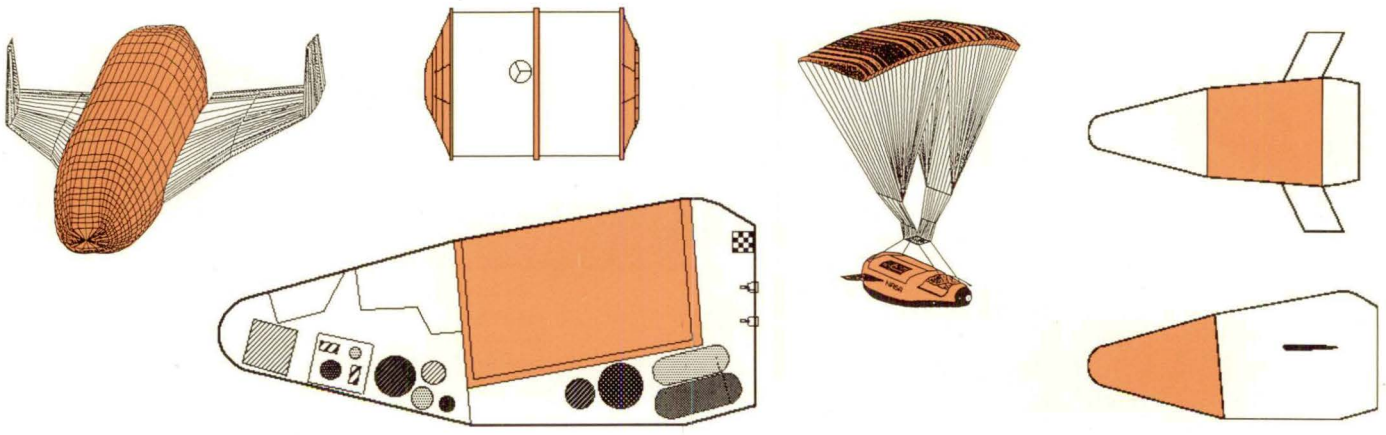
The integration of real-world design projects with the classroom is one of the main goals of the USRA Advanced Design Program, according to its director, John Alred. "The program was started six years ago as a result of industry saying that students were not prepared for what they were going to do in the real world," he says. The theoretical background of engineering was being taught well in universities, according to Alred, but young engineers were getting no experience with design methods used in industry, such as large design teams and the systems engineering approach. The Advanced Design Project addresses this by tapping engineering students' skills on real-life projects for the space agency.

Professor Vano rates the first year of the design collaboration as highly successful, both in research and educational terms. So do the members of the class. "This was probably the most real-to-life, useful class I've taken," says senior Peter Thompson. Classmate Bill Frauly agrees. "The class has been great. It prepared us for getting out into the actual field and for what we're going to be doing, hopefully, in the near future."

Next year's NASA design project will be picked with care, according to Vano. "It must be one that needs the special skills that aerospace engineering students have acquired here at the University of Minnesota," he says. Whatever project is chosen, he adds, it must meet educational goals as well as generate useful designs. This year's CRV project seems to have met both of these goals.

"Our primary responsibility is to educate and to teach the design process," says Cook. "Along the way, we've been able to come up with good, reasonable data that can be used by NASA and some pretty innovative ideas by the students. I think we've hit both levels pretty well." I

James Marti is a research assistant in the physics department.



IT led the way as the number of University patents soared during the last decade

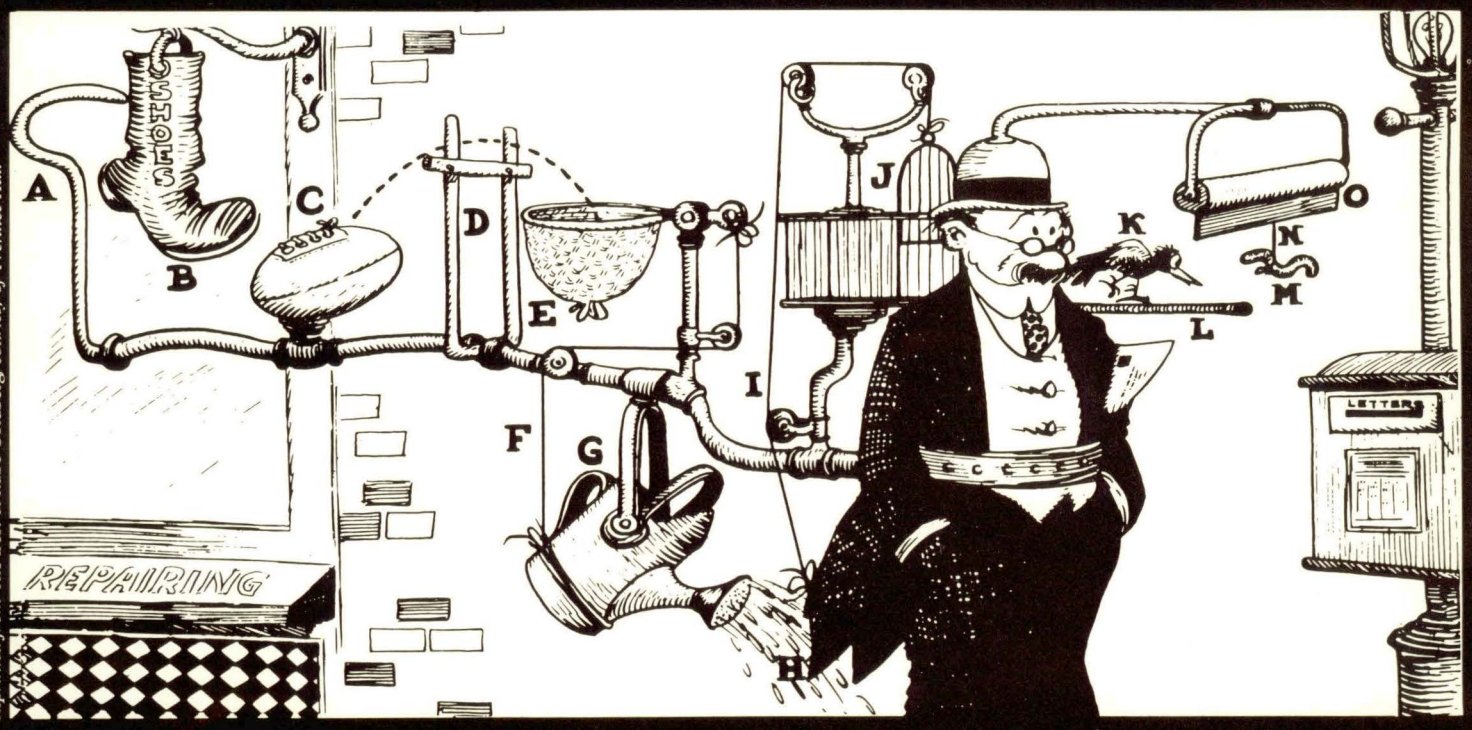
In 1980, the federal government gave U.S. colleges and universities a gift that keeps on giving—it made these institutions the owners of inventions they developed through federally funded research. Realizing that federal agencies were doing almost nothing to patent and transfer new technologies to U.S. industry —which was losing its competitive edge in many areas—Congress opted to let universities try their hand at technology transfer.

Now, after a decade spent gearing up their patenting and licensing offices, colleges and universities are showing strong indications they know how to play the hand. Between 1976 and 1986, the number of patents issued to U.S. colleges and universities tripled. That number then doubled from 1986 to 1990. Led by the Massachusetts Institute of Technology's 102 patents, the top 10 patenting universities received 502 patents in 1989. The University of Minnesota has been among the top 10 patenting universities for the past four years, although the competition gets stronger every year; the University fell from fourth in 1988 to seventh in 1989 despite increasing its patents from 26 to 41 during that time. Twenty-four of the 41 patents assigned to the University in 1989 were issued for inventions by IT researchers.

IT has traditionally led the University in patenting, with its faculty and alumni responsible for the start-up of such companies as Rosemount Inc., Thermal Systems Inc. (now TSI), and Medtronic Inc. They were also responsible for the development of the taconite process, which saved Minnesota's mining industry in the

By Michael P. Moore

The push to patent



Reprinted from The Best of Rube Goldberg, *courtesy of Prentice Hall*

Professor Butts gets caught in a revolving door and becomes dizzy enough to dope out an idea to keep you from forgetting to mail your wife's letter.

As you walk past cobbler shop, hook (A) strikes suspended boot (B), causing it to kick football (C) through goal posts (D). Football drops into basket (E) and string (F) tilts sprinkling can, (G) causing water to soak coat tails (H). As coat shrinks cord (I) opens door (J) of cage, allowing bird (K) to walk out on perch (L) and grab worm (M) which is attached to string (N). This pulls down window shade (O) on which is written, "YOU SAP, MAIL THAT LETTER."

1950s and still results in iron ore shipments valued at over $1 billion per year.

"The change in the patent laws in 1980 really put the onus on universities to do more patenting," says John Thuente, director of the University's Office of Patents and Licensing. "It mandated that royalties be shared with inventors, which provided good incentives for university researchers to seek patents." Thuente was a member of a University committee that drafted a new patent policy enacted by the Board of Regents in 1986. After direct expenses of patenting and licensing are recovered from royalties, the new policy returns one-third of net royalty income to the University for patent protection and technology-transfer activities and one-third to the inventor. The other third goes to supporting the inventor's research (25 percent) and the college to which the inventor belongs (8 percent).

Since 1983, disclosures of potentially patentable inventions at the University have risen from 30 to 160 per year; the number of patents received per year has gone from 5 to 41; active license agreements have increased from about 20 to 119 per year, bringing in about $2 million annually; and research funding by industry has increased from about $3 million per year to more than $12 million.

"In the last three or four years I've seen a great deal of professionalization of the licensing function within universities," says Lita Nelsen, associate director of MIT's Technology Licensing Office. "What happens is that if you're a professor and you see there's an office that is successful at licensing, then you start to do disclosures that you may never have done before."

Thuente says the benefits that have resulted from the changes in the federal patent policy go way beyond a specific institution or local economy. "In my opinion the economic benefits to the country as a result of changes to the patent law have been incredible," he says. "Now you've got about 500 people nationwide licensing technologies to industry, usually at about a 5 percent royalty rate. So, for every $5 received by universities in royalty income, there is $95 generated in business activity, just at the first level of net sales."

Although Thuente expects patenting and licensing activity to continue to build as more universities become skilled at identifying patentable technologies, he believes there is still room for improvement. "If we had the time and the mechanisms for meeting with faculty one on one and examining various aspects of their research, I think we could pull out considerably more valuable ideas than are currently being disclosed to us," he says.

Thuente also believes the federal government could do more to foster the transfer of technology by funding patent and licensing offices in universities or assisting with the patenting costs, which most institutions find to be expensive. "They could also do some things that would give greater exposure to federally funded ideas," he says. "For example, the Department of Energy (DOE) has relationships with companies that could use some of the new technologies resulting from DOE-funded university research. DOE could sponsor a tech fair, for example, in which companies come to look at technologies brought in by various universities. I think the companies in this country are lagging behind those in several other countries in realizing the value of ideas that are coming out of universities. I'm not sure why that is, whether it's the 'not invented here' syndrome, or whether it's the much-criticized inability of U.S. companies to plan long range. But if this thing is going to work, U.S. companies have to get more on the bandwagon."

Faculty and graduate students are also crucial to the success of a university licensing program, Thuente says. "I think most faculty are highly respected by their peers in industry, and the fact that they are excited about a piece of technology is one of the greatest selling aspects you can have," he says. "A person like myself simply can't generate that kind of interest within a company. We try to minimize the time faculty spend in the patenting process, but I think they should be prepared to help people in our office track down good licensees."

The amount of time faculty members and universities spend on patenting activities has been criticized by some who fear that these changes come at the expense of teaching and that they will draw researchers away from basic research into more applied research directed by industry's short-term needs. MIT, which

The inventor mentor

Professor Raymond M. Warner, Jr., first noticed Roger Gravrok in his junior-year course on device electronics. "At that time, the class had more than 200 students in it, and Roger was one of the few who had enough gumption to stand up and ask questions whenever something wasn't clear to him."

Gravrok's memory of Warner follows suit. "He was the first person to describe clearly to me how a bipolar junction transistor works. I was working myself through college repairing consumer electronic products, but I never really understood that basic concept until Professor Warner explained it in class."

The respect Gravrok felt for Warner's dedication to teaching grew into a desire to work with him as a graduate student. "I probably wouldn't have gone to graduate school if not for Ray. When I told him I was thinking about applying and asked him if he would be my adviser, he just beamed and said 'sure.' Then he said, 'It will probably help your chances of being accepted if you write on your application that you intend to accept the research appointment Dr. Warner has offered you.' " Thus began a close personal and professional relationship between mentor and student.

Warner had spent the first half of his 40-year electrical engineering career in industry. "In my last two positions, the companies looked on engineers as technicians, and I decided I had had enough of that," Warner says. "I had kept in the back of my mind the possibility of becoming a faculty member for a long time, so I went back and hit the books and then gave it a try." He joined the University's Department of Electrical Engineering in 1970.

For the next 19 years, until his retirement in 1989, Warner thrived in his three roles as teacher, researcher, and inventor. Gravrok, the last of his nine Ph.D. students, says Warner "has an ability to see potential in people. He gives you positive feedback, and gives you second and third chances to succeed."

Warner says his love of inventing came from his father, a chemist in the rubber industry who invented the cold patch for inner tubes. His approach to inventing, however, came from an experience at Bell Labs. "My first few bosses gave me the impression that there were only a select few who were qualified to be inventors and who would get a stroke of genius one day. But then I got a marvelous boss named Henry Stone, who taught me that you could approach inventing in a systematic way. I continued to work that way through the rest of my industry and university careers, and I now have about 25 issued patents—most of them 'medicines for which there's no known disease,' " Warner jokes.

"Over the years I encouraged students to be constantly thinking of ways to improve what they were working on, and to write those ideas down in a bound notebook with numbered pages," Warner

earns between $3 million and $4 million in annual royalties, plus a couple million more in company equity, is sensitive to those concerns, according to Nelson. "We are very careful to make sure patenting and research with industry don't take away from the academic mission," she says. "We see our function as peripheral to, rather than part of, the mainstream of MIT's mission. I think you have to stress the basic, long-term teaching and research mission, because if you start to slide the other way and focus more on short-term product-development work, then who's going to be doing the basics? We'll have killed the goose that lays the golden eggs."

Thuente and his colleagues have worked to protect the University of Minnesota's basic mission, while encouraging patent activity. He and Tony Potami, associate vice president and director of the Office of Research and Technology Transfer Administration, helped draft a document titled, "Guidelines on Interactions with Industry," which points out the benefits of such relationships as well as their potential risks. They also helped draft a policy called, "Disclosure of Financial Arrangements with Industry," which was approved by the Board of Regents in 1988. It outlines administrative approval procedures for company-sponsored research if the participating faculty member has financial interest in, has professional status with, or receives personal payments from the sponsoring company.

Thuente says he has seen no signs of diminished commitment to teaching among the faculty inventors with whom he works. "The sense I get from a large number of our inventors who teach both graduate and undergraduate classes is that they remain very involved in the teaching process," he says. "Almost invariably when I meet with them in their offices, there is a constant stream of students knocking on the door; and you can tell they enjoy spending that kind of time with students. And looking at the number of student co-inventors we have, I think the faculty with whom we deal are pretty good instructors."

Despite the focus on patenting and licensing, technology transfer involves much more, Thuente says, such as information exchange—another area in which the University, and IT especially, have improved in recent years. "I think centers like the Center for Interfacial Engineering, the Productivity Center, and the Particle Detection Laboratory can be very valuable, especially if you have a number of companies that are interested in basic types of problems and if they can agree up front that it doesn't matter who gets to use the ideas coming out of these centers," he says. "But if you've got proprietary technology, where a company wants a specific problem solved, or wants to fund further development of an idea generated at the University, then I think it has to be a more individual relationship through a research agreement, licensing of a specific patent, or a consulting relationship."

Thuente and Potami are especially hopeful that the University's ability to exchange technical information will be improved by Minnesota Project Outreach, an interactive, on-line computer network that will be available in late 1990 to small and medium-sized companies in Minnesota. Potami developed the idea for the project and succeeded in convincing the Minnesota Department of Trade and Economic Development and the Greater Minnesota Corporation to become partners with the University in the Minnesota Project Outreach Corporation, which was established by the state legislature in 1989. The project will give companies access to hundreds of technical databases, descriptions of academic scientists' areas of expertise and research projects, and telephone consultations with technical experts in Minnesota and the nation.

Potami says he expects the University to become increasingly active in technology-transfer projects as more companies realize the value of academic ideas and as more money becomes available for developing inventions to the point where they are licensable. MIT's Nelsen agrees: "Science is moving so fast that companies are realizing they can't develop all the initiatives themselves, and they're starting to be much more aggressive about looking for technology." I

Michael P. Moore is the communications coordinator for the Office of Research and Technology Transfer Administration.

Photo by Sher Stoneman

Roger Gravrok and Ray Warner

continues. "I would frequently say to students, 'Write that down, write that down!' Not all, but many of my students were intrigued by the challenge to do something that hadn't been done before. Roger's a prime example; he even logged the number of pages by month. So it's a student motivation tool; it gives them another dimension of the learning experience."

Gravrok truly did enter another dimension when he studied the design constraints involved in integrated circuit design and decided to challenge one of the dogmatic aspects of high-speed computing: the inevitability of random errors caused by electronic noise. While playing with various aspects of circuit logic, he began to see a possible route to a circuit design that would be virtually immune to noise, making it possible to build faster, more reliable computers. "I took the idea to Ray, and he said, 'Go with it.' "

Gravrok received his master's degree in electrical engineering in 1986 and then spent the next three years investigating the noise-immunity concept for his doctoral research. "There was really no 'Eureka!' moment," Gravrok says, but rather the evolutionary process of inventing he learned from Warner. The result was the development, testing, prototype circuit fabrication, and patenting of Complementary Noise-Immune Logic (CNIL).

CNIL was the subject of Gravrok's thesis in 1989; in the acknowledgements he writes: "Finally I express my gratitude to the CNIL concept itself; I am honored that it waited for me to stumble upon it." Also in 1989, Gravrok was issued a patent titled, "A Novel Family of Noise-Immune Logic Gates and Memory Cells," and, as co-inventor with Warner, a patent titled, "Complementary Noise-Immune Logic." Warner was also co-inventor on two other patents issued in 1989, one for a "Channel-Collector Transistor," and another for a "Monocrystalline Three-Dimensional Integrated Circuit."

In the fall of 1989, Cray Research Inc. invited Warner and Gravrok to present the CNIL concept at the firm's product development center in Chippewa Falls, Wisc. The presentation went well, and even though Cray has not yet decided whether it will license the invention, it does have a new employee: Roger J. Gravrok, Ph.D., Senior Integrated Circuit Design Engineer.

I

FACULTY

Road warrior

Adjusting to Minnesota winters has been a breeze for David Newcomb. And if the roads he's helping design hold up to this chilly climate as well as he has, the annual outbreak of potholes that plagues Minnesota drivers may someday be eliminated. Newcomb, a Texan by birth, arrived in Minnesota a year and a half ago to develop research plans and assist with design details on the Minnesota Road Research Project (MN/ROAD) for the civil and mineral engineering department.

As technical director for MN/ROAD, Newcomb will help test the effects of cold weather and traffic on one of the highest truck volume routes in the state—a 3.2 mile stretch of Interstate 94 located about 40 miles northwest of the Twin Cities. The project, which is expected to take at least 20 years to complete, will test road construction, maintenance, and design.

As assistant professor of civil engineering, Newcomb will also help implement a new program in pavement engineering that will include classes in pavement design, construction materials, and construction quality control.

Roadways are Newcomb's specialty—a specialty he fell upon by accident, he says. As an undergraduate student at Texas A&M, he worked for the Texas Transportation Institute testing pavement materials. After completing a bachelor's degree in engineering and a master's degree in civil engineering, Newcomb took a position at the Engineering Research Institute in New Mexico. That work led him to the University of Washington in Seattle where he earned his Ph.D. in 1986. After teaching two years at the University of Nevada, Reno, he headed north to the University of Minnesota.

By way of explaining his fascination with roadways, Newcomb says that rocks and asphalt are the most challenging materials with which to work. "Characterizing them is difficult because they don't always behave the same way," he says. "They're different from metals, which are very consistent. Asphalt is an incredibly complex material. People have spent their entire

By way of explaining his fascination with roadways, Newcomb says that rocks and asphalt are the most challenging

Aerospace Engineering

Professor ***Daniel Joseph*** was elected to the National Academy of Engineering, one of the highest professional distinctions accorded an engineer. Among Joseph's accomplishments is the development of ingenious analytical tools and laboratory experiments used in the discovery and elucidation of novel fluid mechanics phenomena. Professor ***C.C. Hsiao*** retired in June 1990, after 25 years in the department. Hsiao plans to continue active research on the crazing of polymers in his new role as professor emeritus. He will also continue to advise three of his current Ph.D. students and plans to write two books—one on general damage mechanics and one on unified strength and fracture theory of solid systems.

Chemical Engineering

Professor ***Kenneth Keller*** rejoined the faculty during spring quarter. Keller had been serving as a consultant to the Council of Foreign Relations in New York.

Chemistry

Regents' professor ***Paul G. Gassman*** received the 1990 CMA National Catalyst Award from the Chemical Manufacturers Association. The award, which honors Gassman for his contributions to teaching, includes a $5,000 stipend, medal, and citation. Professor ***Edward Leete*** received the Minnesota Award from the Minnesota Section of the American Chemical Society. The award honors Leete for his distinguished career in teaching and research during the last 40 years. Leete, who earned his Ph.D. in 1950 from the University of Leeds, England, joined the faculty at Minnesota in 1958. ***Doreen Leopold,*** assistant professor, received the 1990 American Society for Mass Spectrometry Research Award for Young Mass Spectrometrists. The award provides Leopold with $25,000 to support her research. Professor ***C. Alden Mead*** was elected a fellow of the American Physical Society. Mead was cited for "contributions to the theory of line shapes, the optical properties of materials, molecular spectroscopy, and non-equilibrium statistical mechanics." The University awarded professor ***Louis Pignolet*** the 1989-90 Horace T. Morse/Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education. The award includes a numbered edition of a Katherine Nash sculpture, a certificate, and an honorarium. Assistant professor ***Scott Rychnovsky*** has been named a University of Minnesota McKnight Land-Grant Professor. Rychnovsky, one of seven faculty members throughout the University to receive such an award this year, will receive research support and other benefits for three years.

Civil and Mineral Engineering

Dick Braun, professor and Center for Transportation Studies director, was named engineer of the decade (1980s) by the Minnesota Society of Professional Engineers. Professor Charles Fairhurst visited the Soviet Union in February as a member of a delegation from the U.S. National Academy of Sciences to discuss nuclear safety and radioactive waste management issues with colleagues in the Soviet Academy of Sciences and the Institute of Nuclear Safety. Associate professor ***Efi Foufoula*** received a $5,400 Graduate School Grant-in-aid for research in stochastic modeling and simulation of extreme rainstorms. Professor ***Catherine French*** and two of her former graduate students, Olanrewaju Amu and Charbel Tarzikhan, were selected by the American Society of Civil Engineers Structural Division as the recipients of the 1990 Raymond C. Reese Research Prize for their paper "Connections between precast elements-failure outside connection region." Professor ***Ted Galambos*** was recognized by *Engineering News-Record* for pioneering research done in the gradual acceptance of load and resistance factor design for steel buildings. ***Karl Smith,*** associate professor, received a Bush Sabbatical Program supplement to support his sabbatical during 1990-91. During his sabbatical, Smith plans to write three books: two on active learning techniques and one on expert system building. Professor ***Charles Song*** has been appointed a fellow and a member of the Advisory Committee of the Minnesota Supercomputer Institute. ***Heinz Stefan,*** professor and associate director of the St. Anthony Falls Hydraulic Laboratory, was a visiting professor at the University of Sao Paulo, Brazil, in March. He discussed problems related to water quality and physical and mathematical modeling with the staff of the Hydrotechnical Research Center and lectured on models of aquatic environments. Associate professors ***Henryk Stolarski*** and ***Vaughan Voller*** each received Faculty Summer Research Fellowships of $4,300 for this summer.

Computer Science

Professor ***Oscar Ibarra*** has resigned after 20 years in the department to accept a faculty position at the University of California—Santa Barbara.

materials with which to work. "Characterizing them is difficult because they don't always behave the same way," he says. "They're different from metals, which are very consistent. Asphalt is an incredibly complex material. People have spent their entire lives trying to chemically analyze it. It's a nightmare to most chemists."

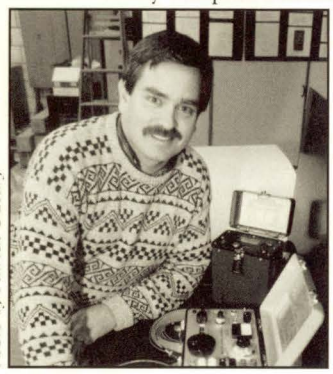


Photo by Patrick O'Leary

David Newcomb

Work on the roadway began last summer with the building of a state-of-the-art ("not another like it in the world") weather station and a weigh-in-motion system to weigh trucks as they drive over the surface. Grading of the roadway will begin this summer, and paving is scheduled for next year.

MN/ROAD should supply some long overdue information on road construction. The last road test of a similar scope was done in the late 1950s in Ottawa, Ill., where test tracks were built and 20 years of traffic was simulated during a two- year period.

"But that didn't tell the whole story," Newcomb says. "The Ottawa project tested only for the traffic variable. It didn't explain the interaction of 20 years and the environment."

MN/ROAD will take those variables into account. It is the first experiment designed to test the effects of weather on roadways in a northern-tier state. "All the technology we use in the pavement industry today is based on research conducted more than 30 years ago," Newcomb explains. The methods developed then were applicable to existing conditions.

Much has changed in the intervening years. Thirty years ago most trucks used bias-ply tires instead of steel-belted radials. Furthermore, the frequency of trucking has dramatically increased due to the closing of many railway lines. And some of the best materials used to build roads, such as aggregate rock, have been depleted.

"We're designing roads for conditions that no longer exist, using tools developed 30 to 50 years ago," Newcomb says. "So every time we design a road, we don't know if it will behave the way we want it to. MN/ROAD should modernize pavement technology and create tools that are flexible enough to accommodate future change." I

By Miriam K. Feldman

Vipin Kumar, associate professor, received honorable mention in the Third Annual Gordon Bell Prize Awards presented by the Institute of Electrical and Electronics Engineers (IEEE) Computer Society. Kumar's award was in recognition of his superior effort in practical parallel processing research. His research showed that large-scale parallel processors can be effectively used for solving practical problems in computer design. Professor ***James Slagle*** received a Certificate of Appreciation from the IEEE Computer Society for technical and administrative leadership while serving as chair of the Computational Medicine Technical Committee. Assistant professor ***Wei-tek Tsai*** received an equipment grant from Hewlett-Packard consisting of software engineering equipment to support both teaching and research.

Earth Sciences

Regents' professor emeritus ***Herbert E. Wright*** received the annual award of the Archaeological Division of the Geological Society of America for "outstanding contributions to the interdisciplinary field of archaeological geology."

Electrical Engineering

Professor ***Vern Albertson,*** associate head and director of the Center for Electric Energy, was named a fellow of the Institute of Electrical and Electronics Engineers for contributions to the understanding of the effects of geomagnetic storms on power systems. In April, Albertson met with representatives of the National Research Council Committees, the House of Representatives Science, Space, and Technology Committee, and selected Congressional delegates to build support for a solar-wind monitor satellite that will provide an accurate advance warning of geomagnetic storms. Professor ***F.N. Bailey*** presented a lecture on "QFT Design Procedures for Processes with Mixed Uncertainty" as part of the Air Force Institute of Technology Distinguished Lecturer Series.

Mathematics

George Sell, professor and director of the High Performance Computing Center, has been awarded an honorary doctorate from Leningrad State University, U.S.S.R. The degree was awarded as "a symbol of the great respect held by the faculty of Leningrad State University for the scientific accomplishments of Professor Sell." Sell has lectured in Leningrad on several occasions and collaborated extensively with faculty members from that university.

Mechanical Engineering

Thomas R. Chase, assistant professor, presented a short course, "Object Oriented Databases: Application to Product Data Exchange Using Step (PDES)," at the National Institute of Standards and Technology in Washington, D.C., on April 11 and 12, 1990. Participants were members of PDES Inc., a national consortium formed to accelerate the development of the evolving STEP standard. (STEP is a logical information architecture for exchanging product data between computer integrated manufacturing applications.) Assistant professor ***Kevin J. Dooley*** received the 3M Non-Tenured Faculty Grant for 1990 from the 3M Engineering Systems and Technology Laboratory. The award is a one-year, $15,000 grant, renewable until tenure is achieved. Dooley's proposal, "Knowledge Bases for Continual Process Improvement," will focus on development of a computer-based methodology for quality improvement of process and product. Professor ***Edward A. Fletcher*** recently completed a six-month tenure as a Fulbright Senior Lecturer at the Weizmann Institute of Science, Rehovot, Israel. In addition, Fletcher presented invited lectures at the Technion, Ben Gurion University Desert Research Institute, Volcani Research Institute, and the University of Ankara. ***Richard J. Goldstein,*** James J. Ryan Professor and department head, was in Japan during fall quarter 1989 on a fellowship from the Japan Society for the Promotion of Science. Ryan did research in heat transfer and fluid mechanics and studied educational systems in Japanese schools, universities, and industries. Assistant professor ***Homayoon Kazerooni*** and graduate student Wendy Foslien won the O. Hugo Schuck Best Paper Award from the American Automatic Control Council for their paper titled, "On the Control and Stability of Robots Worn by Human: Theory." Foslien, one of Kazerooni's graduate student advisees, is employed at Honeywell Inc. The IT Student Board gave assistant professor ***Paul J. Strykowski*** the Most Outstanding Instructor Award in Mechanical Engineering, 1989.

Physics

Professor ***Larry McLerran*** was elected a fellow of the American Physical Society "for theoretical contributions to collision of nuclei at extremely high energies." I

ALUMNI NEWS

ITAS president's message

The Institute of Technology's alumni are the single most important source of feedback and support for IT. There are more than 40,000 IT alumni, many of whom support the Institute through their membership in the IT Alumni Society (ITAS). As president of ITAS, I wish to thank those of you who are members for your support and encourage nonmembers to join ITAS and its parent organization, the Minnesota Alumni Association.

ITAS supports IT in many ways. Science and Technology Day, our society's annual meeting and primary fundraiser, was held last November at International Market Square. Approximately 700 students, alumni, and friends of IT enjoyed a gourmet meal, renewed old acquaintances, and heard Allan D. Gilmour, executive vice president of Ford Motor Company, speak on participative management and the quality imperative at Ford. The planning committee is already hard at work organizing Science and Technology Day 1990, which will be held in November.

ITAS has worked with a local design company to develop a society logo. We feel our new logo will do much to increase awareness of ITAS and assist us in producing uniform, recognizable mailers. The three-tier design of the logo represents our commitment to education, research, and achievement and incorporates a "flame of knowledge" within an interpreted "U". Our thanks to Nancy Lavander of Graphic Answers Inc. for her work on this design.

In March, ITAS co-sponsored an alumni program with the Carlson School of Management Alumni Council. "Your Career in a Rapidly Changing Corporate World" discussed career changes from both a proactive and reactive perspective and presented information on career services available at the University and in the Twin Cities. This program was a resounding success, and we hope to offer it again. Plans are progressing for another co-sponsored program on "Subcontracting Intellectual Work," which will most likely be offered early this summer.

The new ITAS logo incorporates a three-tier design representing the society's commitment to education, research, and achievement and incorporates a "flame of knowledge" within an interpreted "U".

Also in March, ITAS sponsored the annual IT department heads update program, "IT Speaks!" Approximately 100 alumni and representatives from the metropolitan area technical community heard from department heads about research activities in their departments. On May 22, ITAS sponsored the dean's reception and student recognition program at the Radisson University Hotel where dean Ettore Infante gave his annual address to alumni and friends and more than 25 outstanding IT students were recognized for their work.

In addition to sponsoring programs and events, ITAS sponsors student scholarships and the annual Paul Cartwright Award; supports student programs and activities, such as IT Week and the IT Board of Publications; sponsors student attendance at leadership retreats and other programs; and represents alumni at IT commencement and on University committees.

Finally, I want to take this opportunity to recognize and thank a very deserving ITAS member and volunteer, Kristine M. Black. Kris has served ITAS for many years as a member of the ITAS Board of Directors and in five officer positions. As president of ITAS during 1987-88, Kris managed the very successful Science and Technology Day, which featured John Sculley, CEO of Apple Computer, as keynote speaker. She has devoted hundreds of hours over the years to ITAS and Minnesota Alumni Association projects. Kris recently accepted a promotion within Unisys and moved to San Diego. While we're sorry to see her go, we wish her well and thank her most sincerely for her commitment and contributions.

Your support and involvement helps maintain, strengthen, and initiate ITAS programs and activities. Please join today and help IT continue to provide science and engineering programs that are responsive to your needs as well as those of the state and its citizens. I

Thomas W. Rusch (Electrical, 1968; M.S. 1970; Ph.D 1973)
President, ITAS

CALENDAR

October

15 Chemical Engineering All-Alumni Reunion
Chemical Engineering and Materials Science Department, 625-1313

Kolthoff Lecture
(Date to be announced)
Chemistry Department, 624-6000

November

19 Van Vleck Lecture
Charles H. Townes, Guest Lecturer
School of Physics and Astronomy, 624-7375

19–20 Symposium on Supercomputer Simulation of Semiconductor Devices
Minnesota Supercomputer Institute, 624-1356

Science and Technology Day Banquet &
IT Alumni Society Annual Meeting
(Date to be announced)
Minnesota Alumni Association, 624-2323

ALUMNI

1946

Ronald K. Sorem *(Geology, 1948 M.S.)* is currently transferring about 5,000 deep-sea research samples to the Smithsonian Institution National Museum. The samples were collected by Sorem and his colleagues while conducting research at Washington State University, primarily on manganese resources of the deep sea floor. After graduating from IT in 1948, Sorem worked seven years for the U.S. Geological Survey. Upon earning his Ph.D. in geology from the University of Wisconsin in 1958, he accepted a position at Washington State University where he taught for 24 years.

1949

Norm Johnson *(Electrical)* has accepted a position as manager of quality assurance for the High Purity Products Group of the Donaldson Company. Johnson is a member of the IT Board. Previously, Johnson held positions as manager of quality improvement and new product introduction at Northern Telecom, director of quality for Honeywell Aerospace Division, director of quality assurance and product safety at Fingerhut Corp., and manager of product assurance at McQuay Group.

1954

Vincent A. Doyle *(Mechanical)* is currently retired and living in San Diego. He has worked for North American Aviation/ Rockwell International in Los Angeles, the Los Angeles County Department of Building and Safety, and as an engineer for the City of Oceanside, Calif.

1957

Henry Hill *(Physics, Ph.D.)* is a professor of physics at the University of Arizona and founder and director of the Santa Catalina Laboratory for Experimental Relativity by Astrometry (SCLERA) at that university. As director of SCLERA, Hill recently helped complete an agreement for a joint research project with Pulkovo Observatory in the Soviet Union. The agreement, which calls for the exchange of researchers and collaboration in analyzing research data, is part of an effort to create a global network of observatories that monitor the sun around the clock.

1978

Michael J. Richardson *(Electrical)* opened an electrical engineering consulting office—M.J. Richardson and Associates—in West Hills, Calif., in 1989. The firm offers power, lighting, and communications systems design for building projects.

1979

Michael Sivertsen *(Physics)* is employed by Northeast Utilities in Waterford, Conn., as a nuclear training instructor.

1980

David P. Herr *(Civil, 1982 M.S.)* in 1987 founded D.H. Engineering Associates, a company that provides design, analysis, and investigation services for new and existing structures. The firm specializes in repair of concrete structures and renovation or rehabilitation of historic structures. The firm, which is based in Boston, is licensed in seven states.

1983

Roger Janczak *(Mechanical)* is a research and development manager for Abbott Laboratories in Chicago. Janczak is married and the father of a one-year-old girl.

Frederick (Rick) Sheldon *(Computer Science)* is a senior engineer and lead engineer for the Advanced Tactical Fighter Distributed Kernel for the Fort Worth, Texas, Division of General Dynamics. He received his master's degree in computer science from the University of Texas, Arlington, in 1988 and is currently pursuing his Ph.D. He is a member of Tau Beta Pi and Upsilon Pi Epsilon. His research focuses on architecture, operating systems, and reliability.

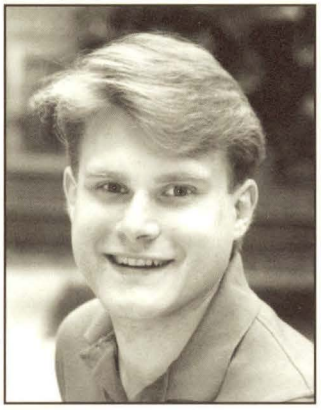
ALUMNI *to p. 20*

Fall *Items* Preview

IT's Finest

Each spring the IT Alumni Society (ITAS) recognizes the Institute's best and brightest students at a dean's reception and student recognition program. Among this years honorees was Loren Eyres, a senior electrical engineering and English major. In addition to completing a double major in five years and participating in a variety of extra-curricular activities, Eyres found time for a tour of duty with the Summer Institute of Linguistics (SIL) in Papua, New Guinea. (SIL is working on a government project to help develop written languages for many of the more than 800 dialects spoken in New Guinea.)

Photo by Patrick O'Leary



Loren Eyres

While in New Guinea, Eyres helped redesign and rebuild the control electronics for SIL's base camp short-wave radio system. "It was very strange to walk up on these grass huts and see solar panels outside and computers and other high-tech equipment inside," Eyres says.

In the next issue of *Items* you'll learn more about Eyres' adventures—both in New Guinea and as an IT student who decided to "develop a different kind of problem solving ability" through his studies in the College of Liberal Arts. You'll also meet some of his fellow students as we profile four of the students honored by ITAS.

In addition to Eyres, the following students were recognized by ITAS for their outstanding work: Tim Abraham, Junior, EE; Timothy Anderson, Senior, EE; Stephan Becker, Senior, AgE; Scott Buss, Senior, ME; Cathleen Bekavac, Senior, ME; Jeff Chan, Senior, EE; Dirk Christianson, Senior, EE; Jeff Conrad, Sophomore, ME; Brian Corrigan, Senior, CSc; Rosamond Dolid, Senior, ME; Tim Eiler, Senior, ME; Maria Gust, Senior, ME; Kee Sook Han, Junior, EE/Math; Eric Huang, Junior, EE; Tom McCaffrey, Senior, ME; Sheri Metcalf, Senior, Math/Statistics; Ann Midje, Senior, CE; Jim Murray, Senior, ME; Khanh Nguyen, Junior, CSc; Thao Nguyen, Senior, ME; Joe Palo, Senior, CE; James Rice, Senior, CSc; Karen Schlangen, Junior, ME; Loren Thomsen, Senior, EE; Jim Willenbring, Senior, EE; Mohammad Zia-Ebrahimi, Senior, Chem; Denis Zilmer, Senior, EE. I

Alumni Survey

The next issue of *Items* will include an alumni survey. The information from the survey will help us better serve your interests and update our records. I

DEATHS

Raye S. Kreevoy, *57,* a pioneer in gerontology and spouse of chemistry professor Maurice Kreevoy. Kreevoy was a native of Boston, where she became a registered nurse after completing her studies at the Beth Israel Hospital School of Nursing. In 1969, she earned a degree in social gerontology from Metropolitan State University and later became cofounder and director of services for the aged at the Jewish Family and Children's Service. There she developed techniques for assessing the problems of the elderly that are now widely used in gerontology. She was instrumental in starting the Minnesota Gerontological Society (MGS) and the Minneapolis Senior Workers Association. In 1987, she received the Creative Nursing Award from the Minnesota Nursing Association. Kreevoy was named Outstanding Gerontologist of 1988 by MGS and also received the Schroeder Award from the National Federation of Jewish Social Service Agencies.

Louis H. Larson *(Civil 1939),* born April 12, 1919, in Hendricks, Minn. Larson supervised major airport and expressway projects in the United States. In the mid-1970s, he formed his own traffic consulting business in Los Altos, Calif. He retired in 1988.

Robert L. Lillestrand *(Physics 1950 M.S.),* 62, chief scientist and vice president of government systems for Control Data Corp (CDC). A prolific scientist and researcher who held 20 U.S. and foreign patents, Lillestrand started CDC's aerospace division and helped develop powerful high-speed image processing computers. In addition to his professional work, Lillestrand was an active explorer, having participated as navigator on two Canadian expeditions to the North Pole. He also participated in cartographic studies of Greenland and helped trace the routes of Christopher Columbus and Sir Francis Drake. Lillestrand maintained an active interest in the IT astronomy department, serving on the Telescope Advisory Committee for the planned Minnesota Astronomical Observatory.

Herbert H. Rosenwald, Jr. *(Civil 1949),* 68, former owner of Bradley Associates, a general contracting firm, and Jersee Security Co., a Minneapolis livestock feed company. A native of Bellingham, Minn., Rosenwald resided in Mesa, Ariz. During World War II, he worked for the U.S. Army Corps of Engineers building air strips in the South Pacific.

Donald F. Sheldon *(Electrical 1940),* 71, a retired electrical engineer. Sheldon was an employee of Honeywell Inc. for 27 years where he worked on the Gemini, Mariner, Mars, and Apollo space programs. He retired in 1971 and resided in Phoenix, Ariz. He was a World War II Navy veteran and a member of the American Legion.

Walter L. Thomte *(Mineral Resources 1935)* of Pine River, Minn. I

Alumni
from p. 19

David P. Tsung *(Chemical)* was recently promoted to section head, microelectronic manufacturing engineering, for E-Systems of St. Petersburg, Fla.

1985

Igor Ostrovsky *(Electrical)* is a product engineer for Honeywell Inc. in their Solid State Electronics Center in Plymouth. I

LETTERS

Don't forget Rose

I was very pleased with the article about the IT Placement Office in the last issue of Items. However, I want to correct one possible misunderstanding regarding the story, which focused on the Placement Office's new facilities and services. Before the recent changes, IT's Placement Office was deficient in nearly all respects but one, the presence of Rose Garmer, a 30-year employee and the "glue" that has held the Placement Office together through both good times and bad. If you are an alumnus or company recruiter who read the article and wondered about Rose, be assured that although the rooms, furniture, computers, and services are new, Rose is still working in the Placement Office, just as valuable and irreplaceable as ever.

Russell K. Hobbie
Professor of Physics
Associate Dean for Student Affairs

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